WHAT IS CLAIMED IS:

1. A semiconductor memory device comprising:

a memory cell comprising a first ferromagnetic film, a tunnel barrier film formed on the first ferromagnetic film, and a second ferromagnetic film formed on the tunnel barrier film;

a side wall insulating film formed so as to surround at least sides of the second ferromagnetic film; and

an interlayer insulating film formed so as to cover the memory cell and the side wall insulating film.

2. The device according to claim 1, wherein the side wall insulating film contacts with the tunnel barrier film.

3. The device according to claim 1, wherein the tunnel barrier film has a higher oxygen content in its in-surface edge portion than in its in-surface central portion.

4. The device according to claim 1, wherein the tunnel barrier film has a larger film thickness in its in-surface edge portion than in its in-surface central portion.

5. The device according to claim 1, wherein the side wall insulating film is formed of aluminum oxide.

6. The device according to claim 1, wherein the side wall insulating film and the tunnel barrier film

contain a common metal element.

7. The device according to claim 1, wherein the side wall insulating film and the tunnel barrier film are both formed of aluminum oxide.

8. The device according to claim 1, wherein the side wall insulating film contacts with at least a part of side wall of the tunnel barrier film along a circumferential direction.

9. The device according to claim 1, wherein the tunnel barrier film is formed of aluminum oxide.

10. A semiconductor memory device comprising:

a memory cell comprising a first ferromagnetic film, a tunnel barrier film formed on the first ferromagnetic film, and a second ferromagnetic film formed on the tunnel barrier film; and

a side wall insulating film formed so as to surround at least sides of the second ferromagnetic film and containing a metal element.

11. The device according to claim 10, wherein the side wall insulating film contacts with the tunnel barrier film.

12. The device according to claim 10, wherein the tunnel barrier film has a higher oxygen content in its in-surface edge portion than in its in-surface central portion.

13. The device according to claim 10, wherein the tunnel barrier film has a larger film thickness in its

in-surface edge portion than in its in-surface central portion.

14. The device according to claim 10, wherein the side wall insulating film is formed of aluminum oxide.

15. The device according to claim 10, wherein the side wall insulating film and the tunnel barrier film contain a common metal element.

16. The device according to claim 10, wherein the side wall insulating film and the tunnel barrier film are both formed of aluminum oxide.

17. The device according to claim 10, wherein the side wall insulating film contacts with at least a part of side wall of the tunnel barrier film along a circumferential direction.

18. The device according to claim 10, wherein the tunnel barrier film is formed of aluminum oxide.

19. A semiconductor memory device comprising:

a memory cell comprising a first ferromagnetic film, a tunnel barrier film formed on the first ferromagnetic film, and a second ferromagnetic film formed on the tunnel barrier film; and

a side wall insulating film formed on the tunnel barrier film so as to surround a periphery of the second ferromagnetic film.

20. The device according to claim 19, wherein the tunnel barrier film has a higher oxygen content in its in-surface edge portion than in its in-surface central

portion.

21. The device according to claim 19, wherein the tunnel barrier film has a larger film thickness in its in-surface edge portion than in its in-surface central portion.

22. The device according to claim 19, wherein the side wall insulating film is formed of aluminum oxide.

23. The device according to claim 19, wherein the side wall insulating film and the tunnel barrier film contain a common metal element.

24. The device according to claim 19, wherein the side wall insulating film and the tunnel barrier film are both formed of aluminum oxide.

25. The device according to claim 19, wherein the side wall insulating film contacts with at least a part of side wall of the tunnel barrier film along a circumferential direction.

26. The device according to claim 19, wherein the tunnel barrier film is formed of aluminum oxide.

27. A semiconductor memory device comprising:

a memory cell comprising a first ferromagnetic film, a tunnel barrier film formed on the first ferromagnetic film and containing oxygen elements, and a second ferromagnetic film formed on the tunnel barrier film, the tunnel barrier film having a larger tunnel resistance per unit area in its in-surface edge portion than in its in-surface central portion.

28. The device according to claim 27, wherein the tunnel barrier film has a higher oxygen content in its in-surface edge portion than in its in-surface central portion.

29. The device according to claim 27, wherein the tunnel barrier film has a larger film thickness in its in-surface edge portion than in its in-surface central portion.

30. The device according to claim 29, wherein the tunnel barrier film contains in its in-surface edge portion a magnetic metal element contained in at least one of the first and second magnetic films.

31. The device according to claim 29, wherein the tunnel barrier film is formed of aluminum oxide.

32. A method for fabricating a semiconductor memory device comprising:

forming a first ferromagnetic layer on a semiconductor layer;

forming a tunnel barrier film on the first ferromagnetic layer;

forming a second ferromagnetic layer on the tunnel barrier film;

patterning the second ferromagnetic layer to expose a part of the tunnel barrier film;

forming a side wall insulating film on the tunnel barrier film so that the side wall insulating film surrounds side walls of the second ferromagnetic layer;

and

patterning the tunnel barrier film and the first ferromagnetic layer.

33. The method according to claim 32, wherein the patterning the second ferromagnetic layer and the formation of the side wall insulating film are carried out within the same semiconductor fabricating apparatus and are continuously carried out inside the semi-conductor fabricating apparatus without exposing the substrate to an exterior of the semiconductor fabricating apparatus.

34. The method according to claim 32, further comprising:

forming a cap layer on the second ferromagnetic layer;

wherein when the second ferromagnetic layer is patterned, the cap layer is patterned so as to have the same pattern as the second ferromagnetic layer, and

the formation of the side wall insulating film comprises:

forming a metal layer at least on the tunnel barrier film and on sides of the second ferromagnetic layer;

oxidizing the metal layer into an insulating metal oxide layer; and

removing a part of the metal oxide layer to leave the metal oxide layer such that the metal oxide layer

surrounds side walls of the second ferromagnetic layer.

35. The method according to claim 34, wherein when the metal layer is formed, the metal layer is also formed on a top surface and sides of the cap layer, and

when the part of the metal oxide layer is removed, the metal oxide layer is left so as to surround the side walls of the second ferromagnetic layer and at least a part of side walls of the cap layer.

36. The method according to claim 34, wherein the formation of the metal layer on the second ferromagnetic layer and the oxidization of the metal layer into the insulating metal oxide layer are carried out within the same semiconductor fabricating apparatus and are continuously carried out inside the semiconductor fabricating apparatus without exposing the substrate to an exterior of the semiconductor fabricating apparatus.

37. The method according to claim 34, wherein the patterning of the second ferromagnetic layer, the formation of the metal layer on the second ferromagnetic layer, and the oxidization of the metal layer into the insulating metal oxide layer are carried out within the same semiconductor fabricating apparatus and are continuously carried out inside the semiconductor fabricating apparatus without exposing the substrate to an exterior of the semiconductor fabricating apparatus.

38. The method according to claim 34, wherein the tunnel barrier film is formed of an insulating oxide,

and

the oxidization of the metal layer comprises:

oxidizing the metal layer and oxidizing an area of the tunnel barrier film which is located immediately below the in-surface edge portion of the second ferromagnetic layer such that the tunnel barrier film has a higher oxygen content in this area than in its area corresponding to an in-surface central portion of the second ferromagnetic layer.

39. The method according to claim 34, wherein the oxidization of the metal layer comprises:

oxidizing the metal layer and oxidizing an area of in-surface edge portion of the second ferromagnetic layer which contacts with the tunnel barrier film to change this area into an insulator.

40. The method according to claim 39, wherein the oxidization of the metal layer comprises:

oxidizing an area of the first ferromagnetic layer which is located immediately below the in-surface edge portion of the second ferromagnetic layer and which contacts with the tunnel barrier film to change this area into an insulator.

41. The method according to claim 34, further comprising:

after oxidizing the metal layer into the insulating metal oxide layer, annealing the metal oxide layer.

42. The method according to claim 32, further comprising:

forming a cap layer on the second ferromagnetic layer;

wherein when the second ferromagnetic layer is patterned, the cap layer is patterned so as to have the same pattern as the second ferromagnetic layer, and

the formation of the side wall insulating film comprises:

forming a metal layer at least on the tunnel barrier film and on sides of the second ferromagnetic layer;

removing a part of the metal layer to leave the metal layer such that the metal layer surrounds side walls of the second ferromagnetic layer; and

oxidizing the metal layer into an insulating metal oxide layer.

43. The method according to claim 42, wherein when the metal layer is formed, the metal layer is also formed on a top surface and sides of the cap layer, and

when the part of the metal layer is removed, the metal layer is left so as to surround the side walls of the second ferromagnetic layer and at least a part of side walls of the cap layer.

44. The method according to claim 42, wherein the formation of the metal layer on the second ferromagnetic layer, the leaving of the metal layer such

that the metal layer surrounds the side walls of the second ferromagnetic layer, and the oxidization of the metal layer into the insulating metal oxide layer are carried out within the same semiconductor fabricating apparatus and are continuously carried out inside the semiconductor fabricating apparatus without exposing the substrate to an exterior of the semiconductor fabricating apparatus.

45. The method according to claim 42, wherein the patterning of the second ferromagnetic layer, the formation of the metal layer on the second ferromagnetic layer, the leaving of the metal layer such that the metal layer surrounds the side walls of the second ferromagnetic layer, and the oxidization of the metal layer into the insulating metal oxide layer are carried out within the same semiconductor fabricating apparatus and are continuously carried out inside the semiconductor fabricating apparatus without exposing the substrate to an exterior of the semiconductor fabricating apparatus.

46. The method according to claim 42, wherein the tunnel barrier film is formed of an insulating oxide, and

the oxidization of the metal layer comprises:

oxidizing the metal layer and oxidizing an area of the tunnel barrier film which is located immediately below the in-surface edge portion of the second

ferromagnetic layer such that the tunnel barrier film has a higher oxygen content in this area than in its area corresponding to an in-surface central portion of the second ferromagnetic layer.

47. The method according to claim 42, wherein the oxidization of the metal layer comprises:

oxidizing the metal layer and oxidizing an area of in-surface edge portion of the second ferromagnetic layer which contacts with the tunnel barrier film to change this area into an insulator.

48. The method according to claim 47, wherein the oxidization of the metal layer comprises:

oxidizing an area of the first ferromagnetic layer which is located immediately below the in-surface edge portion of the second ferromagnetic layer and which contacts with the tunnel barrier film to change this area into an insulator.

49. The method according to claim 42, further comprising:

after oxidizing the metal layer into the insulating metal oxide layer, annealing the metal oxide layer.

50. The method according to claim 32, wherein the patterning of the tunnel barrier film and the first ferromagnetic layer are carried out using the side wall insulating film as a mask.

51. The method according to claim 32, wherein the

tunnel barrier film is formed of aluminum oxide.

52. The method according to claim 32, wherein the side wall insulating film is formed of aluminum oxide.